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vindicate its right to adoption. Are we prepared to accept a convention that makes trigonometry deal with six fundamental quantities, of which sines and cosines are line segments, tangents and cotangents are pure numbers, and secants and cosecants are the reciprocals of line segments—and consequently of dimension minus unity, whatever that may mean? As for the angles on which the whole discussion is conceivably based, why, they do not appear at all; these are all functions of abstract numbers. Is not the relation, $\sin^2 x + \cos^2 x = 1$, worth preserving, when the symbol 1 stands, as it ought, for a pure number? These harsh remarks are, of course, no reflection on the interest offered by the method.

II. THE DERIVATION OF FORMULÆ IN THE MATHEMATICS OF INVESTMENT.

BY C. N. REYNOLDS, JR., West Virginia University.

In teaching the mathematics of investment most of us base the derivation of the formulæ for annuities upon formulæ concerning geometric series which are but faint memories in the minds of most students. Although this links the students' work with their preparatory school work, personal experience in teaching this subject has convinced me that we should make the mathematics of investment an independent mathematical discipline based upon concepts of its own.

In particular I would suggest the adoption of the following fundamental concepts:

(1) The accumulated value of one dollar at the end of n years;
(2) The discounted value of one dollar due at the end of n years;
(3) The present value of a perpetuity of one dollar;

where money is supposed to be worth $100i\%$ per annum compounded annually.

I would suggest that the formulæ for these quantities be made to play the rôle of definitions. The definition of the present value of a perpetuity as $1/i$ could be justified by the fact that if a man deposits $1/i$ dollars in a bank which pays $100i\%$ interest per annum, he receives in return a perpetuity of one dollar per annum, provided that he and his heirs draw the interest from the bank as soon as it falls due. Similarly the other formulæ could be justified.

Having introduced these definitions, an annuity can now be treated as the difference between two perpetuities. For example, the present value of an annuity of n annual payments of one dollar each will be the present value of a one dollar perpetuity minus the discounted value of a perpetuity beginning after n years, *i.e.*,

$$a_{\overline{n}|} = \frac{1}{i} - \frac{1}{i}(1+i)^{-n} = \frac{1-(1+i)^{-n}}{i}.$$

Similarly all the other formulæ of the mathematics of investment can be derived from the three formulæ mentioned above.